FIFTY YEARS OF RESEARCH IN THE NORTHERN GREAT PLAINS

By B. T. Shaw, Administrator, Agricultural Research Service, U. S. Department of Agriculture, before Golden Jubilee Field Day, Mandan, North Dakota, June 17, 1964.

I am glad to have the opportunity of joining you today to celebrate the golden anniversary of research in this Northern Great Plains Field Station.

Celebrations such as this give us an opportunity for the reflection we need to put events and accomplishments into proper perspective. Therefore, in order to see where we started, how far we have come, and where we may be going, let's begin at the beginning.

The beginning of the story told here today goes back more than fifty years. It goes back about a hundred years to the events that led up to the establishment of research stations to develop knowledge about how to farm in the Great Plains.

Pioneer farmers had been pushing westward across the Alleghenies since the time of the American Revolution. They had learned to carve out their farms from the heavy timber lands. They had developed techniques of selecting their soils on the basis of the kind of forest growth that covered them. It was reasonable for them to believe that land which grew only grass had no value for the homesteader. The natural openings -- or treeless meadows -- were more numerous and extensive as they moved west, but the pioneers ignored these areas except for necessary pastures.

By 1850 the frontier of agricultural settlement had reached the eastern edge of the Great Plains, and there it halted. To the pioneers the vastness of the prairie lands was awesome and forbidding, even for their restless spirit of adventure. The endless expanse of thick grasses seemed too powerful to be subdued.

Without timber to shelter game, how could they provide meat for a family? Without timber, how could they build cabins, stock shelters, fuel, fences, furniture, and tools? How could they find shelter from the blowing winds and storms on an open prairie? The answers to these questions created new problems for the western movement of agriculture in this country.

Prairie settlement was further complicated on the Great Plains by the uncertainty of rainfall, the lack of watercourses for transportation, and especially by the Plains Indians. Mounted on horses, these Indians were a much more effective barrier to the advance of the white men than the native population to the east had been. For two and a half centuries the Plains Indians maintained a stronghold against the Spaniards, English, French, Mexicans, Texans, and Americans. They had even withstood the less attractive aspects of spreading civilization, including whiskey, white man's diseases, gunpowder, and lead.

In addition, people of the day generally believed that this region was unfit for white settlement. Geographers were describing large portions of it as the "Great American Desert."

The rush to the gold fields in 1849, and in the years immediately following, made California the principal objective of those who were moving west. The Great Plains and the Rocky Mountain region became merely a long, tedious, and dangerous passage-way to the West Coast.

But the most compelling reason for the halt of the frontier at the edge of the Great Plains was the environment. It was not adapted to the only recognized methods of agricultural production -- and if a family could not support itself from the land, the people could not stay. The climate was strange and unfriendly. The vegetation of the area was strikingly different from that of the eastern part of the country. For nearly twenty years, permanent settlers were baffled by the Great Plains.

Then, during the years of the Civil War, a vast reserve of range cattle had grown up on the Texas Plains. The growth of population in the East and the advance of the railroads into the Great Plains provided both a market and a means for shipping cattle. This combination of circumstances enabled the range-cattle industry to move into and dominate the Great Plains from the late sixties to the late eighties.

Great herds of cattle were driven northward to Abilene and other shipping points in Kansas. Later they were pushed into Nebraska, the Dakotas, and Montana. The cattle were first raised to provide meat for Indian reservations and military posts -- and later to supply eastern markets. The grass supply of the vast range of the Great Plains seemed a permanent paradise for cattlemen.

About 1880 the boom element began to enter this cattle industry. Companies -- financed with outside, chiefly European, capital -- entered the business. The number of cattle increased rapidly, and soon the range was fully stocked.

The range-cattle industry eventually found farming invading its domain from both the east and west. The railroads brought in homesteaders and other land seekers who disrupted the range and forced the cattlemen to shift to a ranch basis. The uncertainties of the business, especially the water supply and the problem of winter forage, had long since demonstrated the value of permanent headquarters.

However, these stockmen were unaware of the rudiments of forage growth and requirements of plants. In a relatively short time the native forage plants were being grazed to the roots and so weakened that they gave place to worthless weeds and annuals -- or even dust heaps. The shrubs along the streams were completely devoured by the cattle, and the meadows dried out. Freshets tore scars in the sod and soil. This destruction was even worse in periods of drought. By the early 1900's the situation was becoming critical.

In the USDA Yearbook of 1915, James T. Jardine, then Inspector of Grazing for the U. S. Forest Service, reported on these grazing lands as follows:

> "From the desert to the line of perpetual snow, there is now little unused range. Grazing, too, has in most cases been unrestricted, with consequent injury to the forage growth. This has gone on until it is evident that, to maintain the production of even the present numbers of livestock under the range industry, run-down ranges must be improved and an efficient system of native pasture management worked out."

Jardine further reported that in 1910 the average area of grazing land required to support one steer on these ranges was 3.8 acres. By 1914, it took over 6.5 acres per steer. He pointed out that overstocking and premature grazing of the land were the principal causes of the problem.

In answer to these well defined needs, the U. S. Department of Agriculture established a number of field stations in the dry lands area. Mandan for the Northern Plains and Woodward in Oklahoma for the Southern Plains were the two major stations. The others were smaller -- and some of these have now been discontinued -- but all have contributed to the accomplishments in making farming in the Great Plains more certain and more productive.

The movement to establish a Federal experiment station here at Mandan was started by a group of the town's citizens in 1908. The station was authorized by Congress on August 8, 1912, and a dryland research program was started in 1914.

During the fifty years of research progress since that time, this station has been fortunate in benefiting from the able leadership of the three men who have served as superintendent: W. A. Peterson, from 1913 to 1917; J. M. Stephens, from 1917 to 1945; and E. J. George, from 1945.

Today, I think we can all join with Mr. George in expressing appreciation for the cooperation through the years of such groups as the North Dakota State University Agricultural Experiment Station, the Bureau of Reclamation, and the Soil Conservation Service. We can join in congratulating Mr. George on the contributions this station has made to the agriculture and economy of the area . . . and to consumers of the products of this land, in all parts of the country.

One of the important contributions made in research for the Plains area is the development of methods and timing of tillage. A major objective of the work was to find a practical method of protecting against water and wind erosion. One of the early recommendations was the use of dust mulch. But more intensive experiments showed that this practice not only did not conserve water, but actually contributed to the deterioration of the soil. So efforts were continued to find a better way.

The development of stubble mulching has proved the most valuable method we've found so far for year-round management of plant residues and for reducing both wind and water erosion. We found it to be particularly useful in the Great Plains where high-producing stubble crops, such as small grain and sorghum are common.

Experiments showed that the time of tillage was more important than the type for summer fallow in the Northern Plains. And that it was best to use as little tillage as possible as long as you control weeds. These and other related findings have helped to make it easier for people to farm on the plains.

The work here at Mandan has also contributed valuable information about plant nutrition in the soils of this area. In the early studies, we found no tangible benefits from the use of fertilizer, except for the stimulation of early spring growth. But more recently, we are developing new and better ways to get beneficial responses . . . and we are modifying our recommendations about the use of fertilizer in the Northern Plains.

We know that continuous cultivation in the area has depleted the organic matter and nitrogen from the soils, particularly in the spring wheat area. We have found in the studies here that several factors influence the availability of nitrogen and phosphorus in the soil. Two of these factors are moisture and temperature. For example, we have found that small grains will respond to phosphorus fertilizer in direct proportion to the moisture supply. In laboratory tests, when the soil was nearly dry, the response was only about two percent of that for a moist soil.

We have also found that the application of nitrogen and phosphorus together improved the response, particularly the plant use of phosphorus. Studies are continuing to find better ways to predict fertilizer response and requirements of plants under various conditions.

Another important accomplishment at this station has been the development of the shelterbelt program.

The early settlers had found it extremely difficult to grow trees and shrubs successfully in this area. Most of the trouble arose from the fact that the newcomers were trying to grow species not adapted to the prevailing climatic conditions . . . that the soil was not properly prepared before planting . . . and that trees were not properly managed after planting.

Experiments were started in 1915 to study the compatability between species of trees, the effect of spacing, the most suitable arrangement of various species, and the hardiness of different kinds of trees.

So far, fifty-five hundred shelterbelts have been planted on farms in the western parts of North and South Dakota, and in the plains areas of Montana and Wyoming. These plantings were made to provide some of the additional information we need about the most effective species of trees and methods of management in growing them. The experiments have also demonstrated these species and methods to farmers in surrounding communities.

The expanding development of shelterbelts in the area has played an important part in trapping and holding drifting snow on the fields to increase available moisture for crops and range. Shelterbelts also help to keep farm yards and buildings free from impassable snow drifts.

Another valuable contribution to agriculture in the Great Plains has been the introduction and adaptation of crops to this area. Beginning in 1898, agricultural plant explorations have been conducted all over the world. Plant explorers have covered many out-of-the-way spots, looking for native plant material that could be adapted to our needs in this country. They concentrated particularly in dry areas looking for cold-resistant fruits and cereals adaptable to the Great Plains. For example, many of the red winter and durum wheats grown on the plains came originally from Russia.

Crested wheatgrass is probably the most important introduced grass species in the Northern Great Plains. This cool-season grass can be grown over the entire region. Stands of crested wheatgrass are useful supplements to the range. They make it possible to avoid premature grazing of the warm-season range grasses until a proper growth has been reached.

However, recent studies of the growth pattern of crested wheatgrass suggest that it may be profitably managed two ways. It may be grazed throughout the spring season until no more forage remains. Or you may end grazing in mid-May to stimulate regrowth. Then, after this crop has been produced, livestock may be turned onto the grass again. The two-crop system yields only about 70 percent as much forage, but provides grazing in late summer when the native range has dried up.

One of the newest possibilities for the region is an experimental hybrid grass, developed by crossing crested wheatgrass and quackgrass. This hybrid seems to have the vigor and leafiness of quackgrass and the drought resistance and seed quality of crested wheatgrass. It would provide valuable forage and cover growth for this area if it proves practical.

In livestock research, this station conducted studies in dairy management during the years from 1928 to 1955. This work helped to improve dairy production in the area in several ways. In the first place, the use of proved sires resulted in an increase in average herd production at the station. This improvement was passed on to commercial herds in the area, as young sires of the station were loaned to cooperating dairymen and surplus males and females were sold.

Dairy production trials showed the comparative value of silages made from grass, sweet clover, oats and peas, and corn. For example, oats and peas silage produced as high yields of milk and butterfat as corn. A pasture rotation system for dairy cattle was worked out to give a long season of palatable, nutritious forage.

Another objective at this station has been to develop species and varieties of fruits that could be adapted to the climatic conditions of the Northern Great Plains. We have conducted studies here with many types of fruits, including apples, crabapples, pears, plums, apricots, cherries, currants, gooseberries, grapes, raspberries, strawberries, and a number of native fruits. During the course of the program, more than 2,500 varieties and selections of fruits have been tested for such qualities as survival, yields, quality, and general adaptation to conditions of the area. At the present time about 1,100 varieties are under test.

This work has demonstrated that varieties of many types of fruit can be successfully grown under dryland conditions if they are propagated on hardy rootstocks . . . given protection from prevailing winds by means of windbreaks . . . and kept clean-cultivated to prevent competition for moisture by weeds.

So far, the station has named and introduced into commercial trade 15 fruit selections. These include five apples, three crabapples, four plums, two cherry plums, and one apricot. Several other selections with superior performance ratings are being considered for release in the near future.

That brings us up to the present and a look to the years ahead.

We still find the Northern Great Plains a land of wheat and range cattle production. During the years of unusually plentiful rainfall, the wheat crops are large and bountiful, but during years of drought there are crop failures, dust storms, and severe loss of topsoil by wind erosion. Farms are large and "neighbors" may live many miles apart.

But through a process of failure and hardship, the people have gradually become adjusted to the limited resources of the area. By increasing the size of farms, and diversifying farming activities as much as possible, farm operators of this area derive a level of living that is equal to the national average, and higher than that of farmers in many other areas who operate under much more favorable conditions.

In the future, however, we still must find ways to improve both the living and the farming. We must continue and extend plant explorations and adaptations to provide more crops for a greater variety in the agriculture. We need better adapted legumes for this area. For example, scientists have been attempting to develop a creeping rooted alfalfa for some years, but we still do not have a variety that is satisfactory on all counts, including hay production. We need alfalfa that produces good grazing and forage without creating problems of bloat.

One of the most important objectives for the future that should be met by research is to strike a better balance between moisture and fertilizers. That means we should put greater emphasis on the study of soil-water-plant relationships. We can expect producers in this area to increase the use of fertilizer in the future. Those of us engaged in research should be prepared to provide more fundamental knowledge about how to make the best use of this fertilizer for the most effective results in the Northern Great Plains.

We should devote more of our efforts toward adapting crops to make the most of the environmental situation as we find it. And there is another direction in which we may find important answers: We have already found a number of ways to minimize the effect of bad weather on the Northern Plains, but we have not yet found out how to <u>capitalize on good weather</u>.

We know that cycles of good and bad seasons are typical in this area. In bad years, producers often have a hard time feeding their stock . . . while in good years they may produce more forage than the animals can use.

If we could find practical ways to conserve and make use of this abundance, perhaps we could extend the agricultural operation to the fullest -- with heavier applications of fertilizer and other practices. By getting every possible ounce of production from the land when conditions are favorable, we could apportion that production in even distribution so there would be no periods of need in bad years. This, of course, is a hope and objective for the future, but there is no reason why we should not be able to attain it.

And finally, we know that livestock production is still of paramount importance in the area, and is likely to continue to be important in the future. We also know that we have not been able to increase the efficiency of beef cattle production anywhere near as much as we have the efficiency of other types of farming.

In order to reduce the cost and increase efficiency, we should take advantage of research results that might be helpful, wherever they may be available. For example, in our beef cattle research, scientists have been able to synchronize the heat periods, through the use of hormones. At first, animals injected with the sex hormone, progesterone, responded to the synchronization but fertility rates were low. Now, the scientists have restored normal fertility rates and timed the heat periods by combining the use of progesterone and small amounts of estrogen.

This practice is still in the experimental stage, but when it is perfected it should be of great value to beef cattle producers in making artificial insemination more practical for large herds . . . and in providing calves that would be born about the same time and marketed in uniform age groups.

We can help to increase efficiency of cattle production by improving the nutritive value of the grasses on the range lands. We need more vigorous, more productive, and more palatable varieties.

And so, if we have come a long way since that first Field Day at the Northern Great Plains Field Station in 1914, we still have a long way to go in solving the agricultural problems of the area. You here at Mandan can be proud of the progress that has been made during the first fifty years of your work. Now, you can build on that progress as you move forward with confidence to find the answers we will need in tomorrow's agriculture.

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